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EXPERIMENTS WITH A NEW METHOD OF
HEATING AND VENTILATION.

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The principle of the method of heating and ventilation discussed in this paper is the utilization of the fact that air rarefied by heating will cause a circulation in the rooms of a building. This principle is applied practically by cooling the air near the ceiling of a room, by heating the air near the floor, or by both means. It has been the belief of the author for some time past that the mechanical condition for such a system of heating might be furnished by the use of "earthen-ware-house" construction in the floors and ceilings, and to test the validity of this belief he carried out the two sets of experiments described hereafter.

The first set of experiments was carried out in the kitchen of the author's village homestead, which was then vacated for repairs. It has a water-backed cook stove piped for domestic uses, to waste in the bathroom on the floor above, and is supplied by a tank in the attic.

The stove was taken out and set in the cellar below, and the flooring and ceiling coverings were ripped out. Porous brickstuff planks, $1\frac{1}{4}$ ins. thick, were then fitted and spiked on the exposed faces of the floor joists, in order to furnish an air-tight and fire-proof foundation. This floor measured 12 x 16 ft., and served as a support for a heating coil composed of lengths of $1\frac{1}{4}$ -in. iron pipe laid 12 ins. apart, and suitably connected with the water-back of the stove on the floor below. This coil was tested for leakage and provided with a petcock to enable air to escape, and the whole floor was then covered with a 4-in. layer of concrete made of equal volumes of native hydraulic lime, sand and small gravel, as shown in Fig. 1.

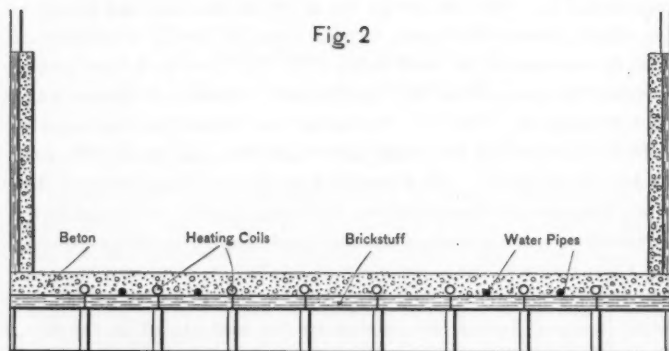
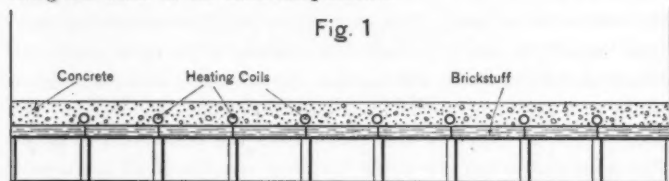
For the purposes of the experiment a temporary ventilating ceiling was made by sheathing the under surfaces of the rafters with $\frac{3}{4}$ -in. matched pine boards. This ceiling was perforated with 144 auger holes from 4 ins. to 6 ins. apart. One-third of these were 1 in. in diameter and the remainder $\frac{3}{4}$ in. Five of the 1-in. holes were provided with tin tubes opening in the floor of the bathroom, and the remainder opened into the wall void, 10 ins. in depth, having direct communication with the outside air.

About three months later, the floor had hardened and the experiment was begun. A platform was put up near the ceiling, the auger holes were corked from below, and blankets were hung over the inside of the doors as an additional precaution against the entrance of the air. A thermometer was affixed to a partition wall at the floor level, another at an elevation of 6 ft. and a third at the ceiling. A fire was then started in the stove and maintained for three hours, when the kitchen was entered. Each of the three thermometers indicated a temperature of 72° , the water in the floor coil was at 135° and the temperature outside the house was 40 degrees.

To rid the room of humidity, the corks were drawn, which was followed at once by a drop of 4° in the reading of the middle thermometer, the others remaining at their former reading. It was found that all the larger orifices, except the five opening into the bathroom, were discharging air downward, while no movement was discernible at the mouths of the smaller ones. The five tubes leading to the bathroom were discharging air upward under a pronounced pressure, although not of a volume equal to that dropped into the room through 43 holes of the same size. The only explanation of this state

of affairs is that the outside air at 40° entering through 43 1-in. holes was pushing up, because of its greater weight, the rarefied air at 72° through 96 $\frac{5}{8}$ -in. holes and the five 1-in. holes leading to the bath-room.

Subsequently the floor of the adjoining room, measuring 16 x 18 ft., was provided with a similar coil, and the experiment repeated with the same results, except that six hours instead of three were required to bring the water to the same temperature.



These experiments show that under the given conditions there is an exchange of hot and cold air at the ceiling, which prevents draughts, and it is practicable to warm a small cottage with kitchen, living room and two bedrooms, having about 500 sq. ft. of floor area, by means of water from the cook-stove.

The second series of experiments was carried out in a small greenhouse annexed to a steam-heated dwelling. The greenhouse was a frame structure measuring 10 x 20 ft. in the clear, and 14 ft. high above the floor. The walls were sheathed to a height of 4½ ft. with brick-

stuff, the remaining distance and the roof being of glass, single sashed but double glazed. The floor was prepared somewhat like that of the kitchen already described, and contained in addition to the heating coil several water pipes, as shown in Fig. 2. The floor was made by soaking brickstuff planks in water before laying them, and using as a covering a mixture of one part of Portland cement to four parts of clean, sharp sand, screened through a No. 6 sieve. The concrete previously employed was not used on account of its deficiency as regards the conduction of heat. The greenhouse has four ventilating transoms beneath the eaves, a small door leading to an open porch and four large folding doors, which, when thrown back, make the greenhouse and adjoining music room practically one large room. The floor coils were supplied with steam from the boiler in the house. The entire cost of the new outfit complete was about \$2 per square foot of floor area.

Sixty days after the completion of the work steam at 7 lbs. pressure was turned on. The outside air was at 29° at the time and the air in the annex at about 65 degrees. It was found by means of smoke tests that the currents of air were rising from the floor to within several inches of the roof, where they spread out horizontally to the walls and sank to the floor. The only ventilation was through a small crevice between the roof and its supporting wall plate, and under the door leading to the porch. The transoms were not used until spring. The mean temperature maintained was 75° during the day and 60° at night, although several times when the outside air was 18° to 22° below zero, the temperature in the greenhouse sank to 52° in the early morning. The furnace fire was banked from 10 P. M. to 6 A. M., the greenhouse being warmed during the interval by the heat stored in the floor. Roses, chrysanthemums, carnations and other plants bloomed freely in their respective seasons, and bulbs, cuttings and seeds were started successfully in the spring.